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SEEDLESS REPRODUCTION OF SEED PLANTS.

ALONG a certain stream side in Lakeland grows the Purple Willow (*Salix purpurea*). The bark of its many stems is purplish red; its catkins come in March, before the leaves, and their scales are blackly purple, the anthers themselves are red and then purple; and so it is easily identified by its name alone. When I first visited this stream the Purple Osier puzzled me greatly; it is very abundant, fringing the wide beck on either side for perhaps a quarter of a mile, and there were many of the staminate catkins, but never a pistillate one. I visited each separate plant and examined it carefully; I satisfied myself that there was no pistillate catkin there. The plants were all male: then how did they come there, so many of them? how had they originally spread along that stream? had the old mother plant died? but how did all the offspring come to be of one sex alone? It seemed too odd!

The answer to these questions came to me not many days later. I had brought home some of the flowering branches and put them in a tall glass jar of water; when I came to empty that jar, the cut ends of the branches had put out roots, some of them an inch or two long, and they were ready to begin life on their own account as new plants. This is what must have happened on that stream side; submerged branches must have rooted, and so new plants sprang from them and spread up and down the brink of the beck, but ever of the same sex as the first plant that happened to begin the colony.

This is one mode of vegetative reproduction, the power that some stems have of throwing out roots; gardeners make use of this power to produce new plants from *cuttings*. All the Ancuba laurels in this country for many years were produced in this way, hence all the plants were female since the first one happened to be so, and never bore fruit because there were no males to fertilize them; much later

the male plants were introduced and planted in gardens where the older ones grew, and they which had been so long barren suddenly began to bear fruit, rich dark red berries.

If the leaf of a Pepper plant or a Begonia be laid on damp soil, roots appear on them in a very short time ; they proceed from the veins of the leaf near the edge where it is turned away from the light. Many plants can be propagated in this manner by cuttings placed in a suitable soil and situation ; it is a much easier and shorter method than growing from seed—I have reared many plants so.

But there are other plants that don't ever grow from cuttings, and I was interested to read the explanation in Kerner's *Natural History of Plants*:—"Limes, roses, ivy, and pinks, the roots of which possess no mycelial mantle, are notoriously propagated easily by putting branches cut from them into damp sand. Rootlets are at once produced on those parts of the branches which are buried in the sand, and their absorption cells carry on the task of taking up nutriment from the ground. But though cuttings of oak, rhododendron, winter-green, bog whortle-berry, and broom strike root, no progress in their development is to be observed, because the superficial cells of the rootlets, in these cases, have not the power of absorbing food when they are not associated with a mycelium. It is only when slips from these plants are put into sand with a rich admixture of humus, the latter having just been taken from a wood or heath and containing the germs of mycelia, that some few are successfully brought to further development. The result is even then often not assured, and the cuttings of several of the plants enumerated die even in sand mixed with humus before they have produced rootlets. Seeing also that the result of attempts to rear seedlings of the beech and the fir in so-called nutrient solutions, where there could be no question of any union with a mycelium, has been that the plantlets dragged on a miserable vegetative existence for a short time and ultimately died, we have good grounds for assuming that the envelope of mycelial filaments is indispensable for the Phanerogams in question, and that the prosperity of both is only assured when they are in social alliance."

Another mode of vegetative reproduction is by *bulbils*, but

this is not at all common. In some rare cases, as in lilies, laterally inserted buds are detached from the plant producing them and give rise to new plants. There is a beautiful red autumn lily which bears a bulbil in each of its leaf axils. I have placed these little bulbils in flower-pots and they have each one, during the next summer, grown into a miniature new plant. Some ferns, again, bear *buds* on the veins of their fronds, which grow upon the frond, without becoming detached, into miniature ferns; one may see a large fern bearing a quantity of young ones on its various fronds, they may be detached, planted in soil, and grown into plants as large as the parent one—I have often done this. *Potamageton crispus* produces in autumn, at the top of its stems at the surface of the water, compact *shoots* of short leaves, which become detached from the old plant and sink to the bottom of the water; the pointed ends bore their way into the mud, and they grow up next season into new plants. This is supposed to be a protective device for quitting the cold and freezing surface region of the water during winter in favour of the warmer zone below. The bud-like tips of other water plants sink also to the bottom for winter rest, and, in the spring, ascend again to produce foliage and flowers on the surface.

Another mode of vegetative reproduction is used much by herbaceous plants; new shoots arise from the root-stock by the side of the old one, and all around it, so that the plant mass grows larger and larger year by year, and it may continually and with advantage be divided; many species of the *Primula* and *Campanula* families multiply themselves in this way. This method seems to lead gradually to the *creeping root-stocks*, cylindrical subterranean stems, with scale leaves, which advance horizontally underground and shoot up into the air at some little distance from the parent plant, spreading out in all directions, like the Lily-of-the-valley and Solomon's seal, and others of the same family. Bulbs, such as those of the Poet's Narcissus, multiply by new ones arising from buds at the side of the old ones, and two or three or four therefore growing in the place of one; the masses of these plants often grow so large that the individual bulbs are too crowded to produce flowers, and need, every second or third year, dividing and rearranging.

Potatoes are multiplied almost entirely by the vegetative mode of *tubers* or thickenings of the underground shoots, which need a resting time of half-a-year and then perish after producing new plants from their buds, the so-called eyes. The Lesser Celandine bears remarkable little tubers, above the soil, in the axils of the leaves; they become detached after the withering of the plant and lie on the ground in numbers, so that they have given rise to a myth of potato rain.

Another device of vegetative reproduction is the *creeping stem*, above ground, developing root fibres close behind the growing point, which, penetrating into the soil or mud, draw the stem down with them; such are the water-loving Bog-bean, the purple Marsh Cinquefoil, and several clovers. In all these the older stems die off behind in three or four or more years. Again there is the *stolon*, a procumbent stem, beset with leaves not far apart, ending in a resting bud; the stolon itself is an ephemeral structure dying off at the year's end, when it has planted firmly, at a distance, the new plant which it bore. The Periwinkle is an example of a stolon that arches, while the Pennywort lies flat; in the latter the tip does not, like the former, thicken and avoid the light, but rooting buds arise in the axils of leaves close to the bent-up tip, which, in the following year, become starting points for new plants.

Several saxifrages, house-leek, common Bugle, and some hawk-weeds produce leafy stolons which root at their free ends, where the leaves group themselves into rosettes, becoming next year new plants, while the connecting stolon disappears. Certain house-leeks develop thread-like stolons ending in rosettes of leaves; when these are quite formed, the connecting stolon withers away, and the rosette, becoming detached, rolls away over the steep rock faces, where the plant naturally grows, till a wider ledge arrests it, and it starts life afresh on its own account. The *runner* differs from the stolon by its longer internodes, with the rooting buds, which are the true organs of multiplication, far apart from them. In the case of the garden strawberry, the plants produce runners on every side of them; the rooted bud at the apex of a runner often produces another runner from it, so that a single plant spreads over a considerable area and forms a host of new plants in a very short time. I

saw this once very remarkably in an old garden that was left to itself for four years; around the edges of a large plot of fruit trees, where the walks ran, was a single row of strawberries; when the neglect began, beneath the fruit trees grew up a vast number of weeds of many kinds, immense dandelions with multitudinous and gigantic flowers, large patches of germander-speedwell, cleavers, all sorts of things; but the strawberries spread each year more and more—when I saw it last they had vanquished everything else under those fruit trees, they had taken complete possession of the whole plot of ground under the fruit trees and of the walks all around it also; nothing was to be seen but strawberry plants, bearing in their season plenty of flowers but no fruit! Other plants, with similar runners, are *Ranunculus repens*, *Potentilla reptans*, and *P. Anserina*, the silver weed, *Geum reptans*, *Rubus saxatilis*, Ground Ivy, and the Japanese Saxifrage, so often grown in hanging baskets.

Many plants multiply similarly by runners that grow as horizontal fibres beneath the soil, and produce from the terminal bud a new plant, often far from the parent one. The Umbellifer (*Ægopodium podagraria*) does this, and the common Valerian, also many of the Labiates. Bulbs even may arise at the ends of subterraneous runners, as in the tulips. All plants with runners, above ground or below, are constantly travelling, and when they get to any soil or climate that suits them they occupy large stretches of ground by ousting all others. Sedges do this and Horsetails. By means of subterranean runners through mud, *Equisetum limosum* and *E. palustre* possess themselves of bog lands or margins of ponds and lakes. The Bracken fern, too, covers acres of dry hill-sides by means of its thick underground shoot axes, lifting only its foliage above the surface.

Several water plants with floating stems resemble the land plants with procumbent stems; at the nodes they develop roots which sink into the mud and leaves which rise into the light; the only difference being that one lives in the water and the other on land, but when the water sinks and the plants with it, even this difference disappears.

I have not mentioned the grasses with creeping underground stems, such as *Triticum repens*, or *Dentaria* (the Tooth cress), similarly creeping below the surface, with

thick fleshy scale leaves and clearly defined roots; there are many others of a like nature and they are seemingly more powerfully equipped for the battle of life by their special mode of vegetative reproduction than are those plants that multiply themselves by means of seeds alone.

It may be broadly said that in any of the various modes of vegetative reproduction, the properties of the parent plant are transmitted to its descendants much more strictly and invariably than is the case when multiplication takes place in the other manner, one plant being more really a part of its predecessor since there is no new start or beginning again from a single cell.

There are many forms that reproduce themselves exclusively in the sexual way, such as the firs, the palms, the cereals; yet the majority of plants have certainly found other means, and of these a very large number produce seed regularly, but apparently as the mere continuation of an old habit, since such seed rarely, if ever, germinates.

SOPHIA ARMITT.